REPORT DOCUMENTATION PAGE

AD-A255 998

1. AGENCY USE ONLY (Leave blank)	2. REPORT DATE	3. REPORT
	15 Sept '92	1987-1991

4. TITLE AND SUBTITLE

Ecological and Environmental Impacts of Corps of Engineers Programs

5. FUNDING NUMBERS

OCE/NRM/92-2

(12)

6. AUTHOR(S)

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7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)

Office, U.S. Army Corps of Engineers
DAEB-CWO-R
Washington, D.C. 20314-1000

8. PERFORMING ORGANIZATION REPORT NUMBER

OCE/NRM/92-2

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)

U.S. Army Corps of Engineers
CECW-RK
Washington, D.C. 20314-1000

10. SPONSORING/MONITORING AGENCY REPORT NUMBER

OCE/NRM/92-2

11. SUPPLEMENTARY NOTES

None

12a. DISTRIBUTION/AVAILABILITY STATEMENT

Approved for Public release;
distribution unlimited

12b. DISTRIBUTION CODE

13. ABSTRACT *(Maximum 200 words)*

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14. SUBJECT TERMS

Natural Resource Construction Programs
Ecological and Environmental Impacts

15. NUMBER OF PAGES

12

16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT
Unclassified	Unclassified	Unclassified	N/A

ECOLOGICAL AND ENVIRONMENTAL IMPACTS OF CORPS OF ENGINEERS PROGRAMS [1]

by

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ABSTRACT

The corps of Engineers provides world-wide engineering services to a variety of customers from both military and civilian communities. Because of this diversity, the Corps routinely encounters technical problems which require practical and timely solutions. In order to provide these answers, the Corps maintains an aggressive research and development program at five Corps of Engineer laboratories. The Corps is a full participant in the R & D community, utilizing the strength of Universities, research institutes, industrial firms, and Corps laboratory personnel in a multi-disciplinary approach to solving civil engineering problems having near-term and long-term impact.

[1] The findings in this report are not to be construed as an official Department of Army position unless so designated by other authorized documents.

INTRODUCTION

Recent research in support of the Civil Works program has concentrated on water resources development, with particular emphasis on environmental problems. In the sphere of navigation and flood control, the problems of ice-buildup on the inland waterways, especially on the Great Lakes, and the effects of earthquakes on dams, locks, and floodwalls are being reviewed with an eye toward developing engineering solutions. Corps-designed river basin models facilitate water resources research since the effects of natural drainage and man-made structures may be tested on these scaled-down replicas of major river basins.

With the recent emphasis on preserving and enhancing environmental quality, the Corps has pioneered policies which led to key environmental legislation and is currently developing new ways to meet the country's water resources needs. The Environmental Effects Laboratory at the U. S. Army Waterways Experiment Station studies the environmental effects of proposed Corps activities and predicts their influence on natural features such as streams, lakes, watersheds, wetlands, and estuaries. By developing scaled models of various ecosystems, researchers are able to investigate the effects of waste discharge, water diversions, and flood control structures on water quality and wildlife habitats .

AQUATIC PLANT GROWTH[1]

Little effort has been made to separate the interrelated effects of pH, carbon dioxide saturation of the water, and concentrations of calcium and magnesium on aquatic plant growth. nevertheless, certain species of aquatic plants have long been associated with waters having low

[1] Abstracted in part from Acid Precipitation in Relation to Agriculture, Forestry, and Aquatic Biology CAST Report 100. June 1984, Ames, Iowa. With permission.

concentrations of calcium and magnesium (soft waters), and others have been associated with waters having higher concentrations of these ions (hard waters).

One case of obvious and direct effect of acidity on aquatic plants involves two large, free-floating species: waterhyacinth and water lettuce. Growth of water lettuce was maximal at pH 4.0, but growth of waterhyacinth was maximal at pH 7.0. Displacement of one of these species by the other has been known to occur in nature, and it is reasonable to believe that pH of the water plays a major role in the dominance of one or the other.

Submerged aquatic plants also are affected by pH and concentrations of calcium and magnesium salts. Various investigators have prepared lists of "acid tolerant" or "acid-loving" plants. There is evidence that acidification of lakes results in shifts of plant populations toward the more acid-tolerant species. Extreme shifts in species can result in radical change in the biological environment of a lake. The outstanding example is Sphagnum, an extremely acid-tolerant aquatic moss. This moss is increasing in some Swedish lakes which are considered to have been acidified by acid deposition. A body of water dominated by Sphagnum is ecologically very different from one in which Sphagnum is not present or is present only in small quantities.

Marked differences in pH preference or pH tolerance may exist, even among species in the same genus. For example, both the pondweeds (genus Potamogeton) and the watermilfoils (genus Myriophyllum) include some species which are associated with acid waters of high calcium content

Algae (primitive plants without leaves, stems, or roots) are important components of the flora of any body of water. They, too, include forms which typically are found in waters of specific pH ranges. Since algae are the basis of many food chains, the types and numbers of algae present affect the entire system. As lakes, ponds, and streams become acidified, the major effect

on the flora appears to be a shift in the species composition, which, in turn, can change the entire ecological complexion of the system.

RESEARCH PLANNING CONFERENCES

A conference on "Human-Accelerated Eutrophication of Fresh-water Lakes" was held at the Teatown Lake Reservation, Brooklyn Botanic Garden, Ossining New York in December, 1973 (11). Evidence of eutrophication was clearly seen in the extent of emergent and submergent weeds and the densities and types of algal growth. In addition to these indications there are chemical and other biological methods to determine the extent and distribution of nutrient levels within a body of water. The number of coliform bacteria indicates the presence of human wastes and is used by health departments to determine potential health hazards of a recreational lake. Oil on water, although not itself a nutrient, causes adjunctive problems in the ecology of the organic system.

A Corps of Engineers Research Planning Conference was held at Atlantic Beach, Florida, October 1976 (8,9,10). Severe infestation by numerous species of submersed aquatic plants jeopardizes continued use of Lake Seminole in Florida and Georgia. In 1976 about one-third of the 40,000-acre impoundment is infested, and both navigation and hydroelectric power generation (for which the project was created in 1955-57) was threatened. Small boat navigation and other recreational activities almost ceased in heavily infested areas between May-November. The biological balance of the lake was upset, including fish predator-prey relationships. Nuisance plants also posed a public health hazzard, as they provide ideal habitats for organisms that transmit

serious communicable diseases. The plants threatened to infest downstream areas as well, including rich oyster-producing areas of Apalachicola Bay. In October 1976 acreage of various plants was estimated: Eurasian watermilfoil (Myriophyllum spicatum), 8000: giant cutgrass, 4500: hydrilla, 1000: waterhyacinth, 800: and alligatorweed (Alternanthera philoxeroides), 50. Chemical control of hyacinth 1958-59 led to phenomenal growth of alligatorweed in the early 1960s, but the latter was effectively reduced by use of the alligatorweed flea beetle, Agasicles hygrophila.

The aquatic plant control and eradication program, state of Texas (final environmental statement) was filed by the District Engineer, Galveston, Texas, July 1972. The project will continue control and progressive eradication of waterhyacinth and alligatorweed in the navigable waters of Texas in the combined interest of navigation, flood control, drainage, agriculture, fish and wildlife conservation, recreation, public health, and related purposes. The project will serve to improve water quality, reduce impediments to navigation and aid in disease-vector control. Adverse environmental effects include a temporary depletion of dissolved oxygen and the emergence of a noxious condition toxic to fish. The amine salt and butoxyethanol ester of 2,4-D used for control of waterhyacinth are extremely toxic to many broadleaf plants. Alternative methods used in the project include chemical control, mechanical control, restricting the supply of nutrients to the water, and biological control.

The control of Eurasian watermilfoil (Myriophyllum spicatum L.) in TVA reservoirs (Final Environmental Impact Statement, Tennessee Valley Authority, Chattanooga. Report TVA-OHES-EIS-72-8. September 29, 1972). This action consists of water level management and application of 2,4-D herbicide in order to achieve and maintain control of watermilfoil to the degree necessary to protect public health and to assure that economic and recreational values of the Tennessee Valley Authority reservoir system are not materially impaired. Beneficial impacts of the project include socio-economic benefits resulting from returning reservoirs and contiguous lands to

maximum potential for recreational and other land uses. Increased production of sport fish as a result of water level drawdown and the removal of shelter for forage fish. Potential adverse effects include low concentration of herbicides in water supplies. Minor damage to nontarget aquatic and terrestrial plants. Minor loss of food and shelter for some fish species and waterfowl and decreased fish spawning. Alternative methods used in this program included mechanical control, biological control, water level management, use of 2,4-D alone and use of other herbicides.

REGULATORY PROGRAM OF PESTICIDE USE[1]

The Environmental Protection Agency (EPA) published in the Federal Register a policy statement describing how the Agency intends to proceed with regulatory decision-making in cases where the standards of the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) conflict with the Delaney Clause of the Federal Food, Drug and Cosmetic Act (FFDCA).

The EPA commissioned the National Academy of Sciences (NAS), as a non-regulatory body, to examine the scientific and regulatory implications of varying standards of food safety contained in FIFRA and the Delaney Clause of the FFDCA. This committee's report, entitled Regulating Pesticide in Food: The Delaney Paradox, issued on May 20, 1987, is the result of this study.

The "paradox" occurs because the standard which the Agency is required to apply to pesticides under FFDCA section 409 is different from the standard under FIFRA and FFDCA section 408. FIFRA specifically directs the Agency to balance the risks and benefits of pesticide use. Similarly, section 408 of the FFDCA requires that EPA give appropriate consideration to the

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1 Abridged summary of the Environmental Protection Agency response to the National Academy of Science Study on regulating Pesticide Residues in Food.

necessity for the production of an adequate, wholesome, and economical food supply. Thus, both FIFRA and FFDCA section 408 provide for balancing the risks and benefits of a pesticide use.

However, the "Delaney Clause" of FFDCA section 409, which applies to residues in processed food products (often called food additive tolerances) says that "no additive shall be deemed safe (and therefore no 409 tolerance may be set) if it is found to induce cancer when ingested by man or animal, or if it is found, after tests which are appropriate for the evaluation of the safety of food additives, to induce cancer in man or animal...." Literally interpreted, the Delaney Clause sets a "zero risk" standard for pesticides that induce carcinogenic responses in test animals, even if the risk is extremely small or inconsequential because the oncogenic potential of the pesticide is weak and/or human exposure is very low.

The Delaney Clause became increasingly problematic for the Agency in cases where pesticides were found to meet the risk/benefit test of FIFRA, but not the Delaney standard. In judging new pesticides and new uses of "old" pesticides, the Agency has consistently applied rigorous interpretation of the Delaney Clause. However, where new test data required by EPA on older pesticides have raised questions about the retroactive application of the Delaney Clause, the Agency has until now deferred making chemical-specific decisions.

These questions have arisen during EPA's review of existing pesticides for two reasons. First, new risk data in some cases have indicated that a pesticide with previously approved registrations and food additive tolerances induces tumors in test animals. Second, in other instances, new residue data have indicated a need for food additive tolerances for certain uses of pesticides that are known to induce some degree of tumor response in laboratory animals.

Pesticides uses that require food additive tolerances do not necessarily pose risks higher than pesticide uses that do not need food additive tolerances, and when a pesticide is marginally

oncogenic, EPA questions whether a strict, retroactive application of the Delaney Clause would in fact serve the overall safety of the food supply. (1,2,3,4,5,6,7, 8).

National Academy of Science Recommendations

The NAS Study report makes four principal recommendations.

1. All pesticides should be regulated on the basis of a consistent standard, so that there is no "double standard" for raw vs. processed foods or for old vs. new pesticides.
2. A uniform negligible risk, rather than "zero risk", standard for carcinogens in food, consistently applied, will best enable EPA to improve the overall safety of the food supply, with only modest reduction in benefits.
3. EPA should order its regulatory priorities by focusing first on the most worrisome pesticides on the most-consumed crops.
4. The Agency should adopt a comprehensive analytical framework for forecasting the broad-scale impact of its regulatory actions on specific pesticides on the overall safety of the food supply.

Environmental Protection Agency Response

The first two recommendations are the crux of the issue. A consistent negligible risk standard makes the most sense scientifically. But the report also pinpoints the agency's greatest difficulty in implementing these recommendations, "Current law and regulations governing residues in raw and processed food are inconsistent with this goal." In an effort to develop a plant which incorporates the spirit of the NAS recommendations, and still remains defensible under current law, the Office of Pesticides and Toxic Substances has prepared the attached plan. The Agency expects the effect of this new policy to be a reduction in overall risk to consumers. In the absence of Delaney Clause constraints, all pesticides, new or old, will be evaluated or reevaluated according to a risk/benefit standard. Residues will be considered in light of the risks present --

based on their toxicity and anticipated dietary exposure -- rather than the form of the food bearing them.

However, in the presence of the rather specific language of the Delaney Clause, the Agency cannot apply its ideal approach to uses which come under the purview of section 409 of the FFDCA. Only a legislative solution would allow the full implementation of the Agency's favored approach and the recommendations of the NAS. The plan therefore is only consistent up to a point. Generally, a negligible risk is treated as virtually no risk in the presence of some benefit. An oncogenic risk greater than negligible, where section 409 applies, would rather be a bar to further consideration.

The acceptability of a negligible risk under the Delaney Clause is based on the de minimis legal principle. It is derived from case law holding that an administrative agency ordinarily has the inherent authority to avoid applying the terms of a statute literally when to do so would yield pointless results.

The National Academy of Sciences (NAS) does not define a "negligible risk". Instead it leaves that judgement up to the EPA to determine. However, the report does refer to past practice of both the FDA and EPA. In cases where a quantitative risk estimate has been made, both agencies have used a 10^{-6} (.000001, or 1 in a million) increase in oncogenic risk over the norm as a reference point.

1. **No carcinogenic Effect or Negligible Risk of Carcinogenicity**

   Pesticides classified as Group D or below under the Cancer Association Guidelines or which have quantified risk of 10^{-6} or lower would be registered and granted any necessary tolerances, under FFDCA section 408 or 409, provided they meet all other FIFRA criteria. In general, little scrutiny would be afforded to the benefits, since, in

accordance with current practice, benefits would be assumed from the applicant's willingness to bear the cost of supporting the registration.

2. **Carcinogenic Risk Greater than Negligible**

   Pesticides with a quantified oncogenic risk greater than 10^{-6}, but those benefits exceed the risks, would be granted section 408 tolerances and registered if section 409 does not apply. The plan states that, ideally, section 409 tolerances would also be granted, but that current law prohibits it.

3. Group C chemicals (possible oncogens) are divided into two categories, those for which the Agency deems quantification or risk is appropriate, and those for which the Agency believes quantified risk assessments would yield deceptive results based on the weight of the evidence. If a quantified risk assessment is deemed appropriate, paragraphs 1 and 2 above would apply.

   If the weight of the evidence is less strong, the Agency must evaluate the risk further. If the data are equivocal, unreliable, or subject to significant doubt, or only benign tumors have occurred, the Agency may determine that the evidence does not support the conclusions that the chemical induces cancer in the test animal. If the Agency can provide a logical explanation for why the positive oncogenicity tests are not appropriate for evaluation of the safety of food additives, and the Agency is convinced that the risk is negligible, the pesticide will be treated as a noncarcinogen as in paragraph 1 above.

4. **Currently Registered Pesticides**

   The approach to currently registered pesticides which have either been found to have carcinogenic potential or are classified as carcinogens and have been found to require section 409 tolerances since their registration would be similar to the approach

described above.

However, the Agency would like to apply a risk/benefit evaluation to those cases where the risk is slightly greater than our reference standard for negligible risk, especially in cases where a pesticide use would substitute for a more hazardous chemical and the loss of all alternatives would result in unreasonable economic impacts.

The NAS committee's third recommendation, the EPA focus its energies on reducing risk from most worrisome pesticides on the most consumed crops, is reflected in the Agency's priority system for reviewing old pesticides. Priorities for reregistration review have been set according to a crop grouping scheme (see **Federal Register** vol. 48, no. 126, p. 29855, June 29, 1983) designed to address first those sues which present the greatest potential risks. Therefore most of the major pesticides used on the 15 major crops and animal products have already had a recent review or are scheduled for review in the near future. The Agency's plan includes a status report on the review of each of those chemicals.

However, the suggestion that the most discriminating, and thus most efficient, scenario would be one in which a risk trigger of 10^{-6} would be applied on a crop-by-crop basis could result in a situation in which multiple negligible risks could result in total dietary risk which might be more significant. In other words, if there were no regulatory impact on a widely used oncogenic pesticide until the oncogenic risk from an individual crop exceeds 10^{-6}, multiple crops could contribute a significant greater risk.

The fourth recommendation -- that EPA should develop improved tools and methods to more systematically estimate the overall impact of prospective regulatory actions on health, the environment, and food production -- refers to our computerized risk assessment program.

SUMMARY AND CONCLUSIONS

The ecological and environmental impacts of current natural resource construction programs of the local, state and Federal governments must be carefully evaluated to provide the least common denominator for the interests of the general public

Because some degree of this environmental consciousness is commonplace today, some citizens find it hard to understand why many institutions and government agencies have not always been closely identified with these currently accepted environmental policies. In fact, the more strident environmentalists do not hide their distaste and contempt for large segments of American industry and for many governmental agencies which traditionally have emphasized economic development goals rather than environmental preservation.

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